

Comparison of Geant4 hadronic models with experimental data

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Geant 4

Motivation

- Geant4 is a detector simulation toolkit
- Particles react with material
- Get mean free path for each process
- Choose one at random
- E.g.
 - electromagnetic (Bremsstrahlung, etc.)
 - Hadronic
 - User has a choice of models: binary cascade/
bertini cascade

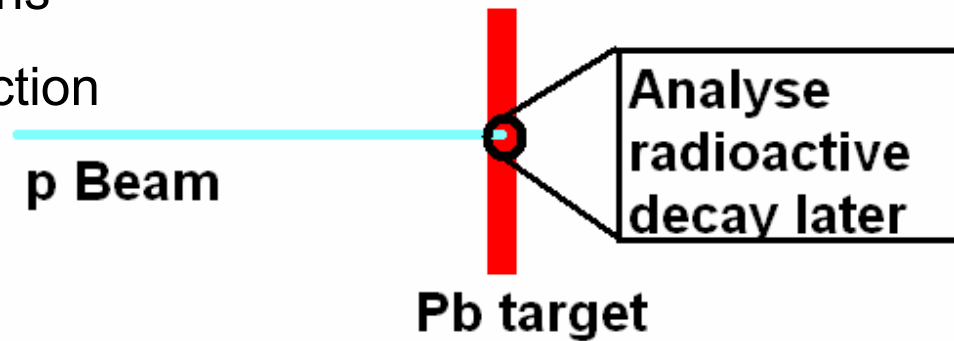
Experimental Geometry

Thin target

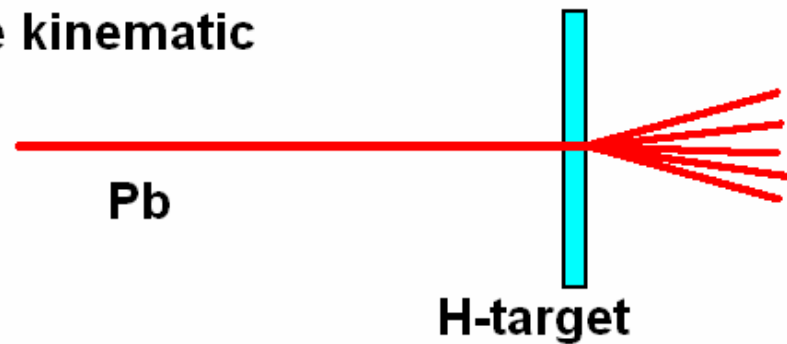
Simulate 200 000 interactions

Get cross section for production of isotopes

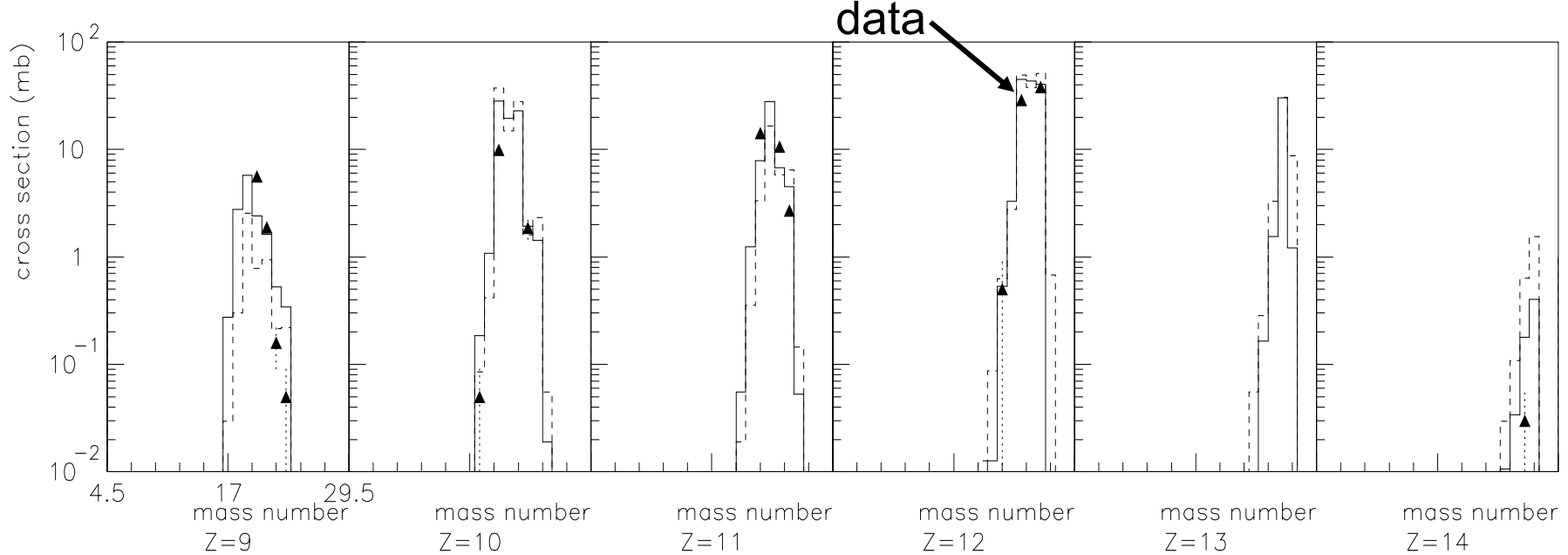
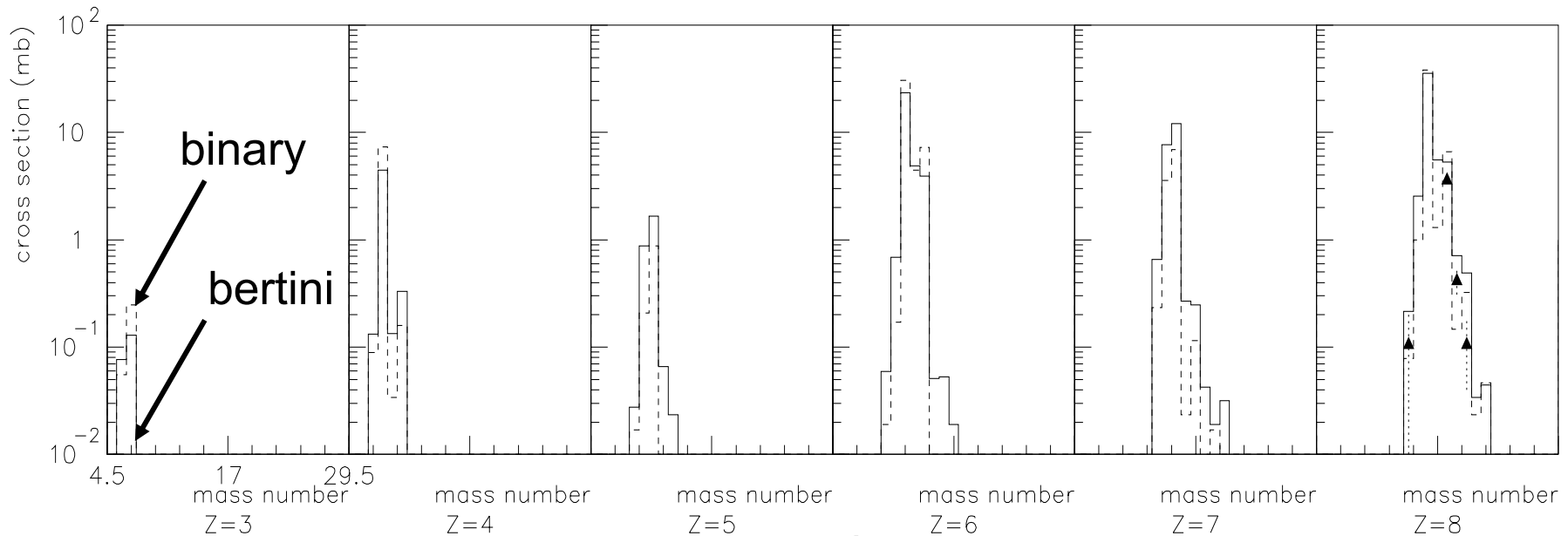
Compare to experiment



Inverse kinematic



Cross section(mb) vs A (for Element Z) in Al(p,X) at 800 MeV

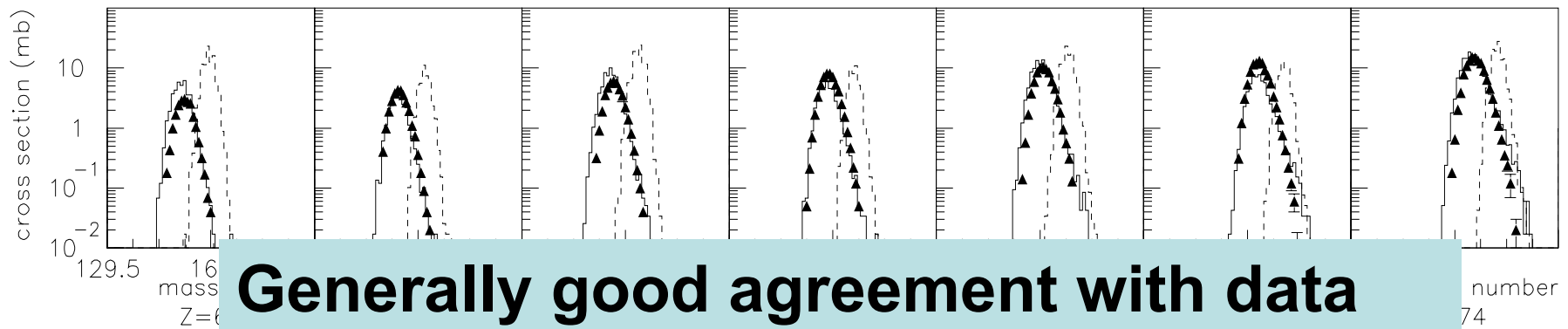
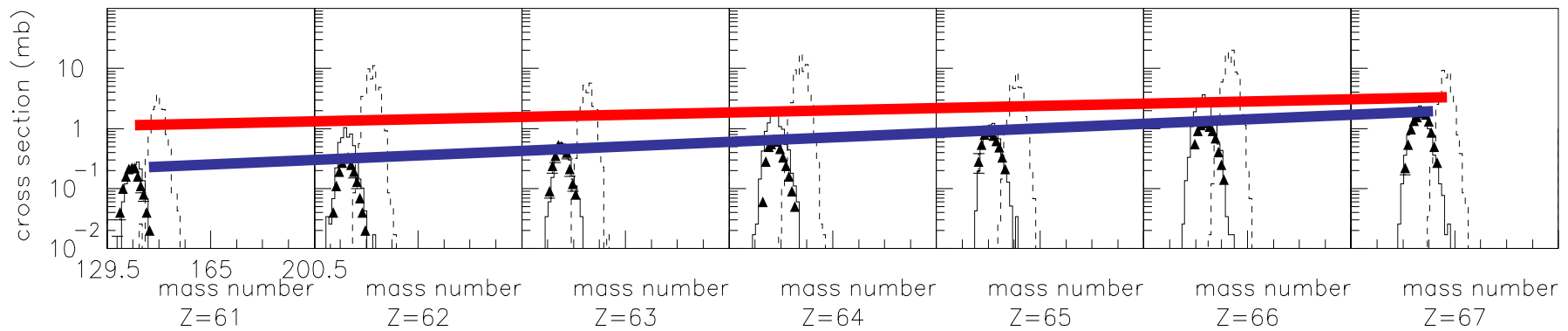


Data: H. Vonach et al., Physical Review C, 55, 2458, 199705

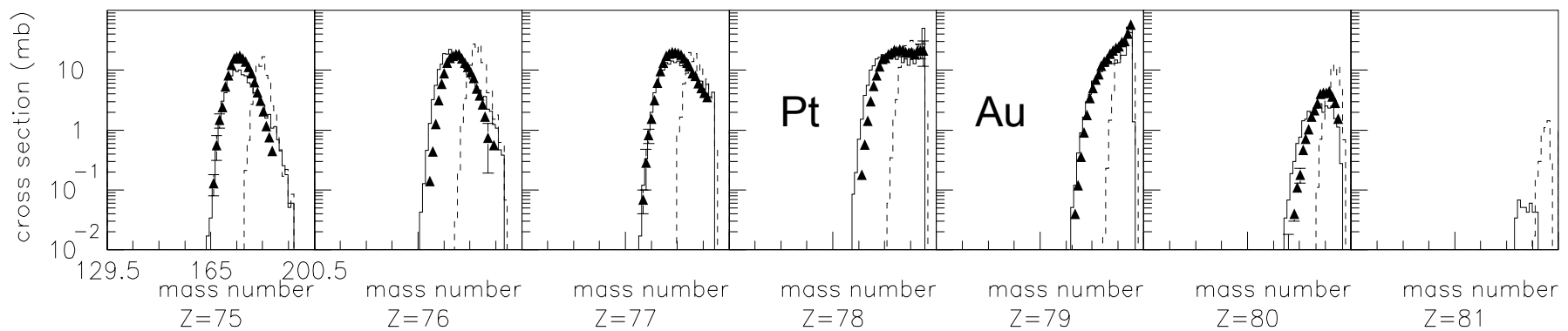
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une	110 Unn								

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Cross section(mb) vs A (for Element Z) in p(Au,X) at 800 A MeV

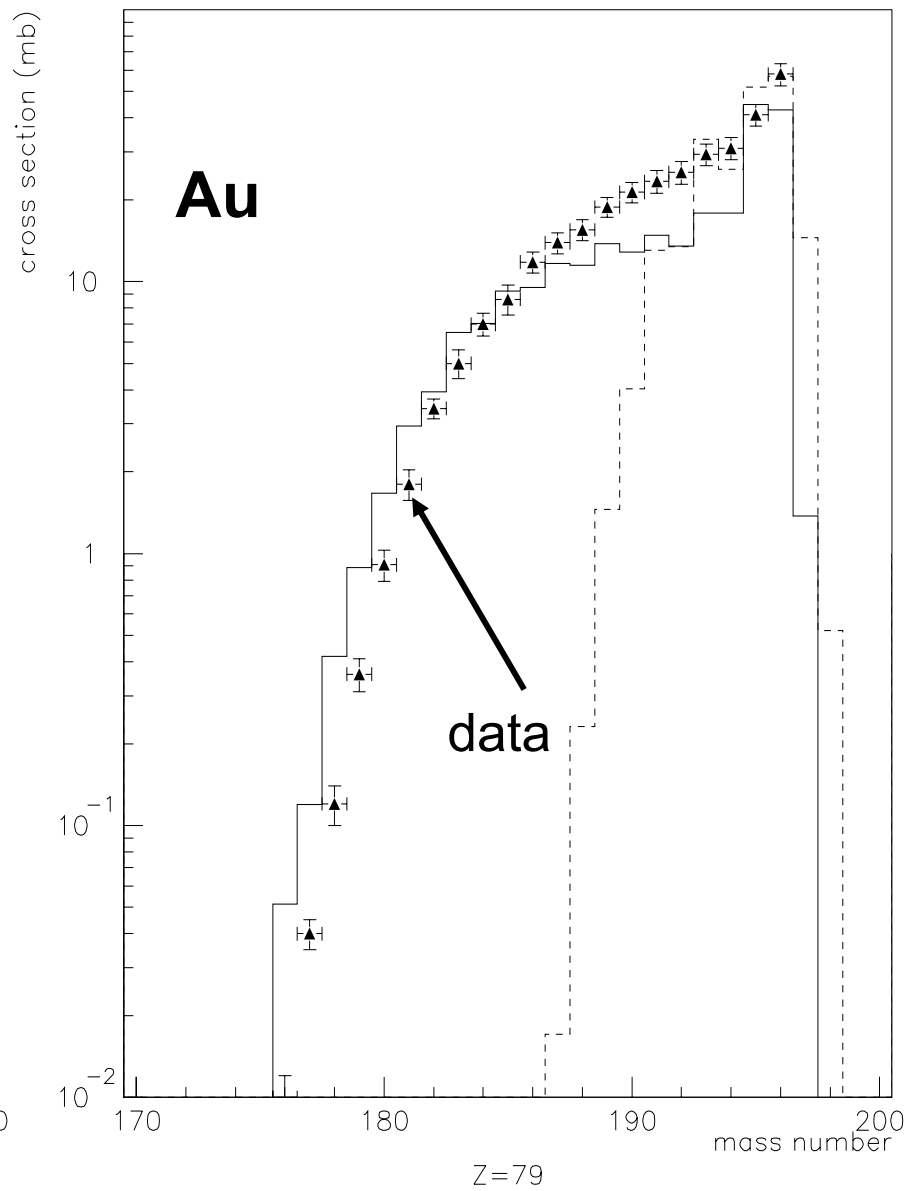
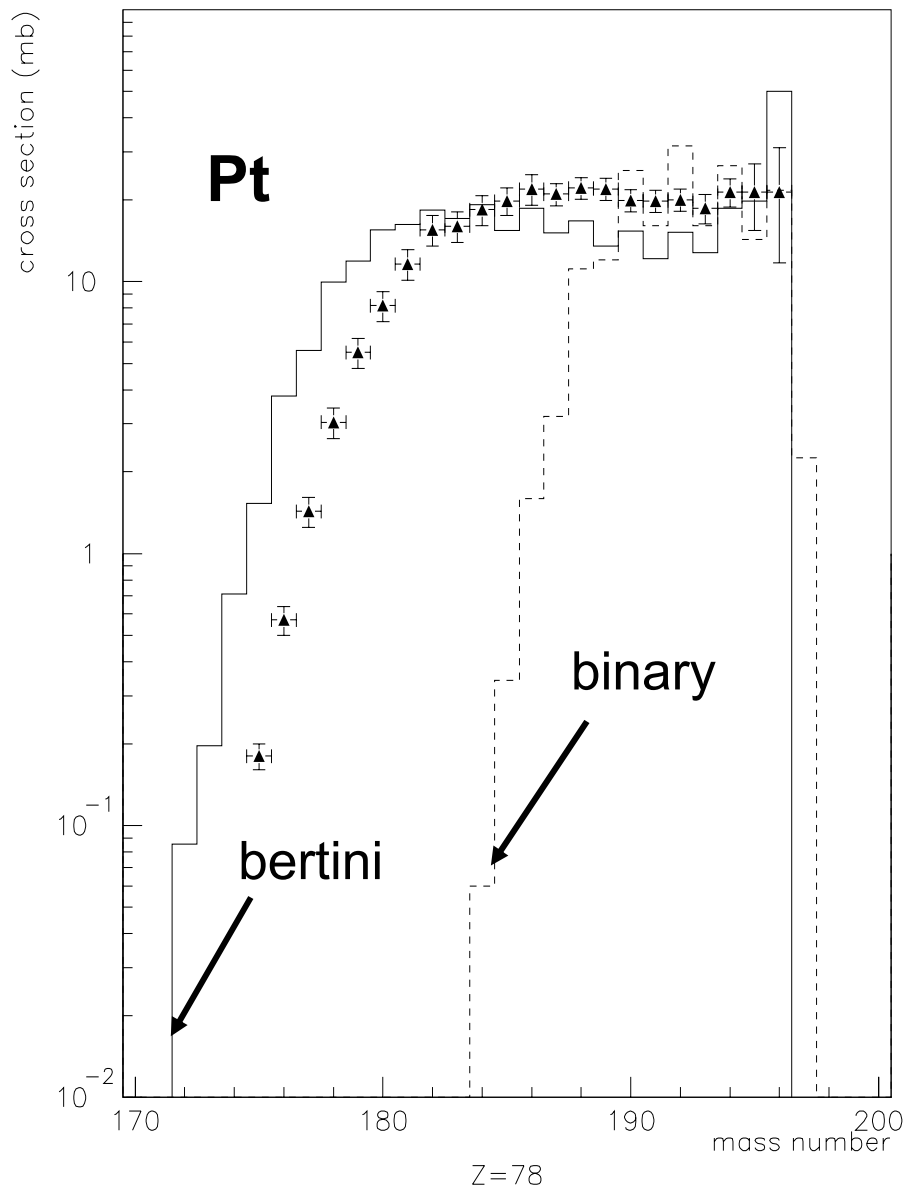


Generally good agreement with data



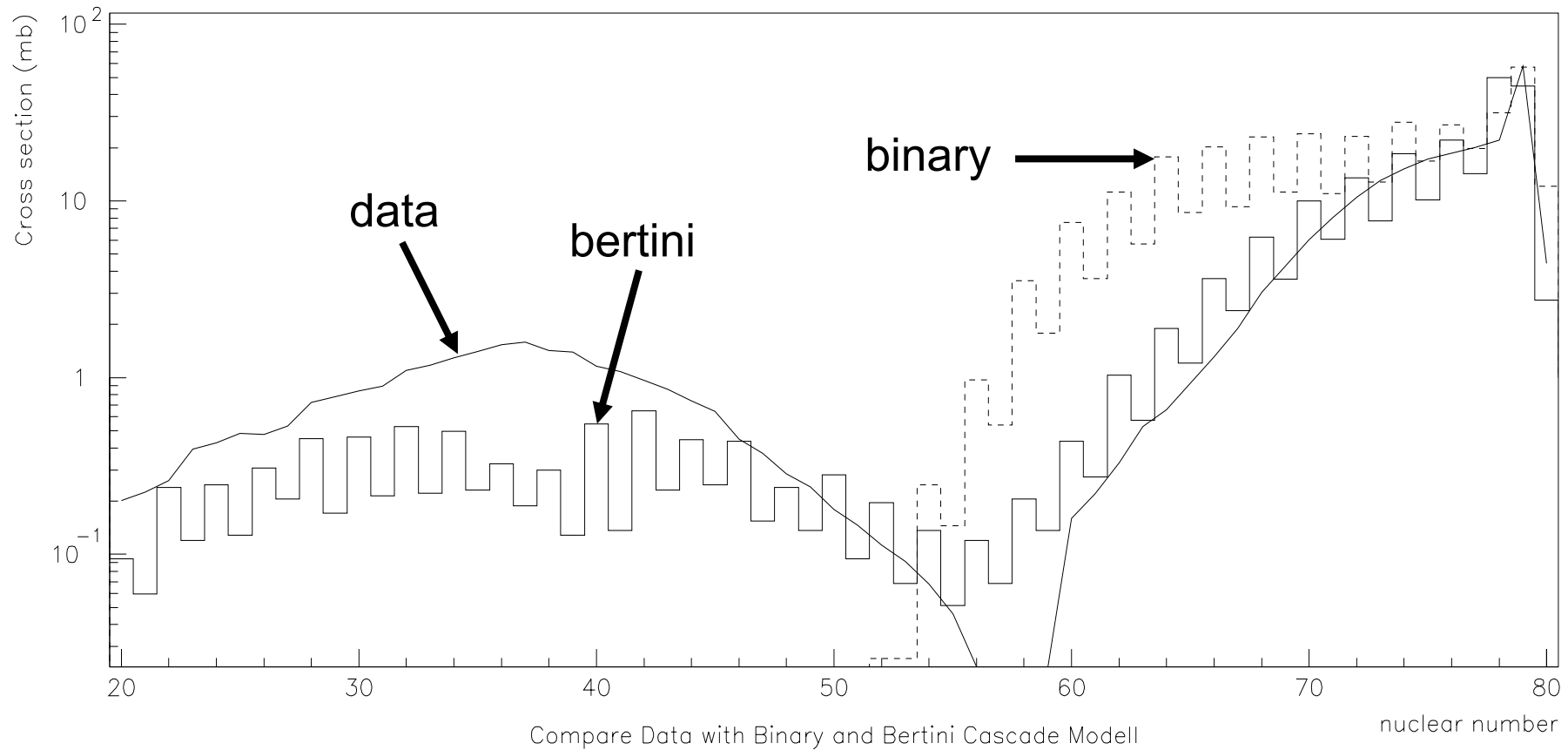
Data: J. Benlliure et al., Nuclear Physics A 683 (2001) 513–539 and F. Rejmund et al., 540–565

Cross section(mb) vs A (for Element Z) in p(Au,X) at 800 A MeV



Data: J. Benlliure et al., Nuclear Physics A 683 (2001) 513–539 and F. Rejmund et al., 540–565

Isotopes with max. Crosssection in $p(\text{Au}, X)$ at 800 A MeV



Bertini cascade:

Not enough light elements

Binary cascade:

No fission in my program

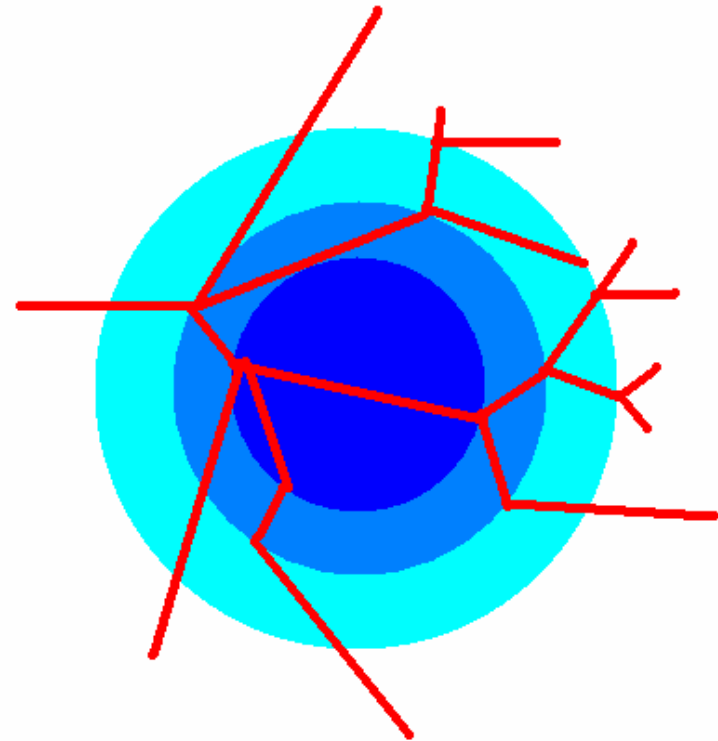
Elements with even proton number are preferred by models

Conclusion

- Bertini Cascade reproduces the slope
- Both models prefer paired nucleons
- Binary cascade must be investigated with fission

Bertini cascade

- Intranuclear Cascade
- Nucleus has continuous layers
- Get reaction products from library



Binary Cascade

- Intranuclear cascade
- Nucleus consists of nucleons
- Reactions are binary

